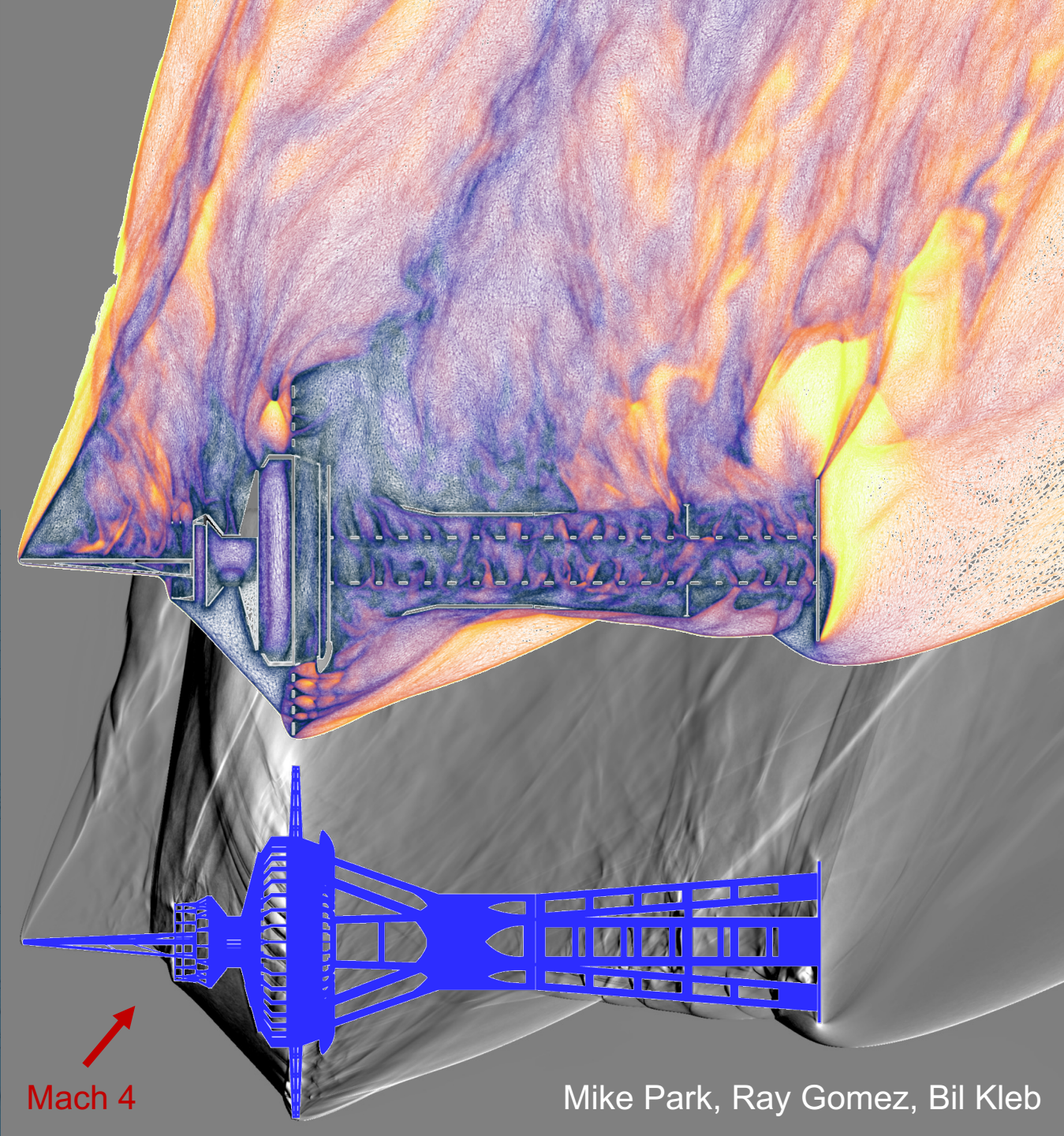
Space Needle Returns



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STEP is imported into Engineering Sketch Pad. Some bodies are slightly scaled and translated in OpenCSM to create a manifold solid for the downstream meshing process. The braces at the base and columns around the core are omitted because their solids are malformed or created nonmanifold intersections. EGADS provides an initial tessellation of the surface. *refine* adapts the surface mesh to a curvature and feature size metric. TetGen initially fills the volume. The TetGen mesh is adapted to the Spalding Law of the Wall u+ with refine to provide the initial flow solver mesh. Solution-based mesh adaptation is performed where FUN3D-FV computes the flow solution with the Reynolds-averaged Navier-Stokes equations coupled to the Spalart-Allmaras turbulence model. The freestream Mach number is 4 approaching 40° from the central axis of the Space Needle. The volume and surface mesh is adapted with *refine* to reduce estimated interpolation error in Mach number via the multiscale metric. The adapted mesh implicitly resolves the boundary layers, shocks, and expansions. The surface mesh is shown on the left for the lee side with a slice through the volume. Computational schlieren in the lower right shows density variations. A slice of the mesh is colored with Mach number in the upper right and shown where Mach is different than freestream. The volume mesh contains 64 million vertices. A NASA worm logo is sketched and extruded into a solid in OpenCSM. The worm is unioned to the Space Needle roof to produce the inset mesh image.